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► To cite this version:

Yann Algan, Pierre Cahuc, André Zylberberg. Public Employment and Labor Market Performances. Economic Policy, 2002, 17 (34), pp.1-65. 10.1111/1468-0327.00083 . hal-01017844

HAL Id: hal-01017844

<https://hal-sciencespo.archives-ouvertes.fr/hal-01017844>

Submitted on 3 Jul 2014

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Public Employment and Labor Market Performances^a

Yann Algan^y Pierre Cahuc^z and André Zylberberg^x

September 2001. Paper prepared for the 34th Panel Meeting of Economic Policy in Brussels

Abstract

This paper deals with the consequence of public employment on labor market performances in 17 OECD countries over the period 1960-2000. It is argued that public employment had an important crowding out effect on the private sector and increased the unemployment rate over this period. More precisely, empirical evidence suggests that the creation of one public job destroyed about 1.5 private job, slightly decreased participation to the labor market and eventually increased the number of unemployed workers by 0.3. Theoretical considerations and empirical evidence also suggest that the crowding out effect of public jobs on private jobs is more important in countries in which public production is highly substitutable to private activities and in which the public sector provides high rents.

1 Introduction

1.1 The problem

In many OECD countries, public employment represents an important share of total employment. Table 1 shows that the average share of public employment¹ in total employment over the period 1960-2000 amounts to 16.6% in seventeen OECD countries. This average share has increased over this period: It amounts to 18.8% in 2000, this phenomenon being often linked to the increase in health and education expenditures.

Surprisingly, few reflections have been devoted to the analysis of the consequences of the public sector on private employment and unemployment. Accordingly, the consequences of public employment on labor market performances is a very open question. Public employment is

^aWe thank without implications Paul Beaudry, Giuseppe Bertola, Pierre-Yves Henin, Francis Kramarz, Etienne Lehmann, Steven Pischke, Fabien Postel-Vinay, Jean-Marc Robin, Etienne Wasmer, an anonymous referee and participants to seminars given at University Paris 1, University of Antilles-Guyane, University of Lausanne and ECARES-Free University of Brussels.

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¹There are many possible definitions of public employment, according to the definition of the public sector. This issue is extensively discussed in OECD (1997). Our empirical part relies on a restrictive definition of public employment provided by the OECD, including jobs belonging to central and local administrations, to non-profit organizations owned or directly financed by public administrations, to army and embassies. Our theoretical considerations also rely on this restrictive definition.

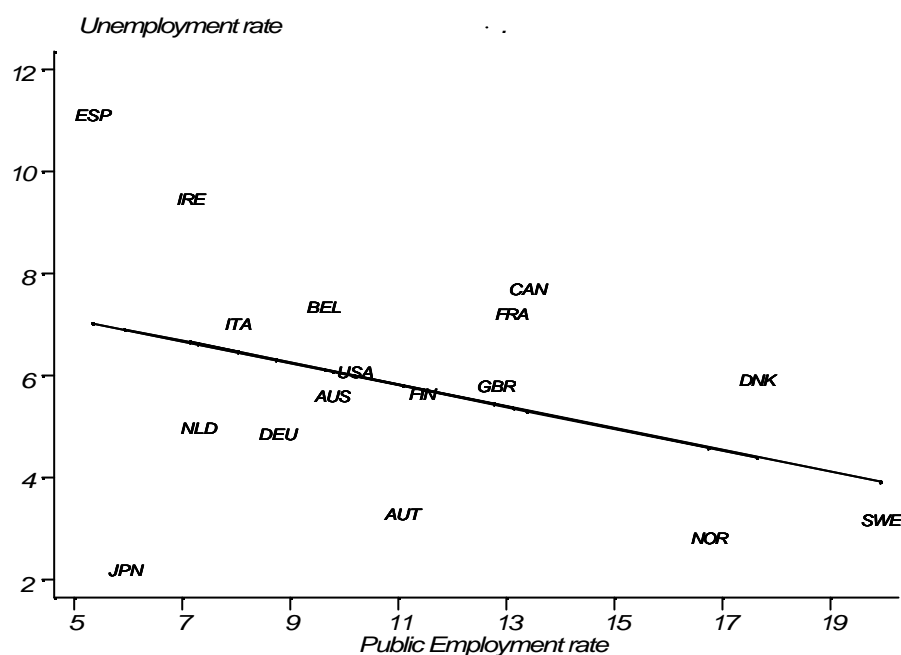


Figure 1: Average rates of public employment and unemployment in 17 OECD countries over the period 1960-2000. The public employment rate is defined as the ratio of public employment over the population in working age. Source: OECD.

sometimes considered as a way to counteract the scarcity of jobs in the private sector, as it is testified by some public employment programs in European countries. From this perspective, the strong positive correlation between the unemployment rate and the size of public employment in most countries of our sample — Table 1, column 3 — could be interpreted as a response of governments to unemployment rate rises. However, public employment is also often considered to crowd out private jobs, by raising taxes, competing for products substitutable to those produced by the private sector and by increasing wage pressure. From this point of view, the positive correlation between public employment and unemployment, displayed in Table 1, can be interpreted the other way around, arguing that public jobs increase unemployment. Nevertheless, Figure 1 suggests that this relation should be interpreted cautiously, since the correlation between public employment and unemployment across countries is negative.

The very contrasted experiences of different OECD countries in matter of public employment stress the strong oppositions between policy makers in this realm. Indeed, it is worth noticing that rich OECD countries have managed public employment in very different ways over the period 1960-2000. In 2000, the size of public sector goes from 8.4% of total employment in Japan to 31.2% in Norway — Table 1. The evolution of the size of public sector over time has also been contrasted. Figures in Appendix 3 show that the rate of public jobs per person in working age has been stable in Japan and the Netherlands, started to increase and then decreased from the beginning of the eighties in Ireland and UK, and increased to a more or less extent in the other countries of our sample.

This brief overview suggests that the public sector may significantly influence private em-

	Public employment Total employment %		σ_u	σ_{L_g}	$\rho(L_g, u)$
	Average 60-00	2000			
Australia	14.6	14.8	3.09	1.56	0.88
Austria	17.0	20.6	1.95	2.27	0.84
Belgium	16.6	18.5	4.41	1.43	0.90
Canada	20.3	19.1	2.35	1.04	0.83
Denmark	23.8	30.3	3.73	5.46	0.88
Finland	16.5	23.2	4.51	3.32	0.68
France	21.1	24.9	3.79	1.14	0.96
Germany	13.3	14.9	3.71	1.34	0.78
Ireland	12.2	11.0	4.45	0.90	0.64
Italy	14.6	17.1	3.19	1.20	0.79
Japan	8.3	8.4	0.99	0.26	0.78
Netherlands	12.9	11.4	2.6	0.25	0.21
Norway	23.9	31.4	1.48	5.00	0.78
Spain	9.9	14.6	8.00	1.75	0.90
Sweden	26.6	30.9	2.18	5.71	0.36
U.K	18.2	13.4	3.49	1.93	0.16
U.S.A	15.4	15.2	1.48	1.03	0.17

Table 1: Public employment and unemployment in 17 OECD countries over the period 1960-2000. σ_u is the standard deviation of the unemployment rate in each country. σ_{L_g} is the standard deviation of the public employment rate, defined as the ratio of public employment over the population in working age. ρ is the correlation coefficient between u and L_g . Source: OECD.

ployment and unemployment in rich OECD countries. Our paper aims at shedding some light on this issue.

1.2 Key results

The first part of our contribution provides a simple theoretical framework, which shows that the impact of public jobs on private jobs depends on two key features of the public sector.

First, the degree of substitutability between the production of the public and the private sector. Obviously, one should expect that public job creation in police, justice, army or in any sector that produces a pure collective good, not substitutable to private production, to have a smaller crowding out effect on private jobs than public job creation in sectors such as transportation, education and health in which private activities can play an important role. It can even be the case that the crowding out effect is negative, if public jobs raise the returns of private activities, by improving their economic environment. But, overall, it appears that the crowding out effect increases with the degree of substitutability between the production of the public and the private sector.

The size of the rents gotten by employees in the public sector is the second key feature that influences the impact of public jobs on private employment. Creation of public jobs that provide higher wages, higher fringe benefits, higher job security and require lower effort than in the private sector is likely to attract many individuals in the public sector, and to crowd out many private jobs. At the opposite, “bad” public jobs with low wages, high instability and hard working conditions are not likely to attract many workers. More generally, our theoretical framework allows us to show that the creation of public jobs, producing a pure collective good, financed by lump sum taxes, decreases unemployment only if the rents gotten by employees in the public sector is low enough.

The empirical analysis of the impact of public employment on labor market performance is a tricky issue. As public employment responds to many of the same phenomena that cause other labor market outcomes, correlations between public employment and unemployment have to be interpreted cautiously. For instance, a positive correlation between public employment and unemployment may arise if the public sector reacts to bad labor market conditions in the private sector by hiring more workers. It would be misleading to interpret this correlation as a positive impact of public jobs on unemployment. Therefore, a proper empirical analysis has to isolate the direct effect of public employment on private jobs from the other effects, that induce correlations between these two variables. This problem is known as the endogeneity issue. From this perspective, our theoretical framework is very useful, because it sheds light on the set of variables that influence both labor market performance and public employment. Accordingly, it helps us understanding the interactions between public employment, labor market performance, and a set of variables, such as productivity growth, the political color of the government, the degree of openness, the urbanization rate and some features of the public sector.

Our empirical results show that public employment played an important role on labor market performances of the rich OECD countries over the last forty years. Quite surprisingly, by controlling carefully for the endogeneity of public employment, we find that public employment raises unemployment in these countries. On average, the creation of one public job destroys about one 1.5 job — the 95% confidence interval being [0.8, 2.3] — and adds 0.3 unemployed worker — the 95% confidence interval being [0.1, 0.6].

Our estimates also show that the crowding out effect of public employment increases with

	High rents in the public sector	Low rents in the public sector
High substitutability	Belgium, Japan, Spain	Denmark, Finland, Germany Norway, Sweden, U.K
Low substitutability	Austria, France, Ireland, Italy, USA	Australia, Canada, Netherlands

Table 2: Country classification according to the level of public rents and the degree of substitutability of public and private jobs.

The public rent is measured by the corruption index and the substitutability of public and private jobs by the share of public expenditure in total health expenditure. If the public rent is measured by the wage differential, there is a change in category for Canada and Austria (data are missing for France, Belgium, Denmark and Finland for this indicator).

If the degree of substitutability of public and private jobs is measured by the share of defense, general public services and public order in total public expenditure, there is a change in category for Austria, Ireland and the UK (data are missing for Belgium, France and Germany).

the degree of substitutability between the production of the public sector and the private one. More precisely, the degree of substitutability of public and private employment is evaluated thanks to the fraction of public expenditure in health on one hand, and the share of defense, general public services and public order in total public expenditure on the other. These two complementary measures allow us to show that the crowding out effect of public jobs is much more important in the group of countries in which the degree of substitutability is larger than the median of all the sample. It is only for this group of countries that unemployment increases as public employment rises.

Moreover, it appears that the public sector destroys more private jobs in the group of countries in which the public sector provides large rents to its employees. Actually, the measure of rent in the public sector is a complex issue, because rents do not only stem from wage differential with the private sector, but also originate from differences in effort, working condition, and the extent of misuse of public power. For this reason, our measure of rents in the public sector relies on two complementary approaches. First, we use the Corruption Perception Index (Lambsdorff, 2000), which evaluates the degree of misuse of public power for private benefits, through various surveys. This index is a number that summarizes the degree of transparency in the public sector for each country. The second measure of rents is the standard public-private wage differential.

According to this investigation, the impact of public employment on unemployment may be very heterogeneous across countries. To get around with this idea, Table 2 defines four groups of countries according to the level of rents in the public sector and to the degree of substitutability of public and private jobs.

It can be seen that the public sector in Belgium, Japan and Spain yields substantial rents and is concentrated on activities highly substitutable to those of the private sector. Both our empirical analysis suggests that the crowding out effect of public jobs is the highest for this group, and that it is only for this group that public employment significantly increases unemployment. It is worth noticing that the size of the public sector is below the median in these countries (see Table 1). Accordingly, the idea that the crowding out effect of public jobs increases with the size of the public sector is not confirmed by our empirical exercises. The impact of the public sector on labor market performance does not seem to be a matter of size. It is mostly related to public jobs features.

At the other extreme, Australia, Canada and the Netherlands couple public rent and substitutability of private and public jobs below the median. For this group of countries, the crowding out effect of public jobs is very low. The four Scandinavian countries, Denmark, Finland, Norway

and Sweden combine, together with Germany and the U.K., both low rents in public administration and a high substitutability between private and public jobs. In this context, it is expected that the crowding out effect of public jobs takes intermediate values, in between those found for Belgium, Japan and Spain, on one hand, and Australia, Canada and the Netherlands on the other hand. Overall, this analysis casts doubt about short-cut conclusions on public employment effects that do not take into account the feature of each country.

Last, but not least, our estimates show that differences in the development of the public sector across our sample countries explained a non-negligible share of the variance of the private employment rates over the last forty years. Indeed, we find that about 12% of the private employment rate dispersion can be explained by differences in public sector size. This number appears quite important if it is compared with the impact of other institutions estimated by other studies. For instance, applying Blanchard and Wolfers' (2000) method, it can be shown that the interactions of common macroeconomic shocks with unemployment benefits, union coverage, union density, the degree of coordination of collective bargaining, the tax wedge, active labor market policies and employment protection explains about 32% of the private employment rate dispersion. Comparing the 12% of public employment with the 32% of the set of institutions usually taken into account in empirical studies suggests that public employment is an important feature of labor markets, which has been surprisingly neglected in the analysis of labor market performances — Nickell (1997), Blanchard and Wolfers (2000), Daveri and Tabellini (2000), Belot and van Ours (2000), Freeman (2000).

1.3 Policy implications

Our results point out that crowding out effects of public jobs on the private sector are actually important, especially if public activities are substitutable to those of the private sector and if public jobs provide large rents. As only very few things are known on this issue, we think that it is important to keep in mind such results to evaluate the efficiency of public jobs. In particular, the importance of the crowding out effect casts serious doubts on the efficiency of large public employment programs to fight against unemployment. Moreover, our analysis suggests that carrying out improvements to the management of the public sector, conducive to lower rents in this sector, may significantly improve labor market performances.

However, our results should be interpreted cautiously. We do not think that it can be inferred that the public sector is necessarily too large or has been growing too fast in some countries in which crowding out effects are supposedly large. Indeed, all countries do not necessarily need the same public jobs density. Exposure to international trade, the level of education, the size of the country, the degree of urbanization, the access to natural resources and many other elements may influence the optimal size of the public sector — see e.g. Hart et al., 1997, and Rodrik, 1998. According to our analysis, the counterpart of a large public sector that crowds out many private jobs may be the cheap access to good health, education and transportation. It is impossible to evaluate the efficiency of the public sector without looking meticulously at its production side. This is a very difficult issue, especially from an empirical perspective, which is far beyond the scope of our paper — Karras, 1996, 2000, provides some evidence on this issue.

Eventually, it is also worth noticing that our analysis does not take into account that public employment may favor some categories of disadvantaged individuals on the labor market. Indeed, public employment proves to have enlarged the access to labor market for categories which have a limited access to it. For instance, the steady rise in public employment during the sixties

and the seventies in countries like Sweden was accounted by the labor market entry of women — see Rosen, 1995. Furthermore, evidence from many OECD countries shows that the gender and the race earnings differential is larger for private sector than public sector employees — Gregory and Borland, 1999. The explanation usually proposed for the variation in the extent of earnings discrimination by race and gender between public and private sector employees is the more extensive implementation of equal opportunity and anti-discrimination policies in public sector labor markets. Thus, if public employment may have a positive impact on unemployment through an increase in labor market participation of individuals who endure discrimination, its benefits in terms of Welfare State may be far from being negligible.

1.4 Related literature

As far as we are aware, only very few contributions have been devoted to the consequences of public employment on labor market performances in a macroeconomic perspective. The two surveys on public sector labor markets in the Handbook of Labor Economics, by Ehrenberg and Schwarz (1986) and Gregory and Borland (1999) show that the literature has mainly focused on the internal organization of the public sector — especially the influence of trade unions — and on wage differentials between the private and the public sector.

Holmlund and Linden (1993) and Calmfors and Lang (1995) have studied the macroeconomic effect of temporary employment programs, arguing that temporary public jobs increase wage pressure in the private sector. Both papers reach close conclusions: The wage pressure increase induced by public jobs destroys private jobs. Holmlund and Linden (1993) conclude that it cannot be ruled out that the offsetting effect of temporary jobs is so strong that unemployment actually increases when hires into relief jobs are intensified, but this outcome is a remote possibility in their framework. Holmlund (1997) yields more insights on the relationship between the public sector and unemployment in a trade-union model. He shows that public sector expansion increases equilibrium unemployment if unions are relatively more powerful in the public sector than in the private sector.

Finn (1998) reaches more stringent results in a real business cycle model applied to the U.S. economy. Finn distinguishes between the goods purchases and employee compensation components of government spending. Then, she shows that positive shocks to government goods purchases increase private output and private employment, whereas positive shocks to government employment have the opposite effects.

The empirical literature confirms the ambiguous impact of public employment on labor market performance. Some empirical evidence is provided by Demekas and Kontolemis (2000) for Greece, and by Malley and Moutos (2001) for Germany, Japan and the U.S. Both papers rely on time series and suggest that public employment has a strong crowding out effect on private employment. Edin and Holmlund (1997) used pooled crossed section and annual time series data for 22 OECD countries over the period 1968-1990. The basic message emerging from their exercises is that public sector employment decreases unemployment in the short run, whereas there is no significant long run effect. Eventually, Boeri et al. (2000, Table 4) have an incidental look at the correlation between non-agricultural employment rate and public employment in a regression that also includes labor market institutions for 19 industrialized OECD countries over the period 1982-1995. They find that the correlation between the non-agricultural employment rate and the size of public employment is about 0.7, this number being significant at the 1% level. Thus, according to their estimates, one public job crowds out 0.3 private jobs. However, it

should be noticed that none of these estimates cope with the endogeneity of public employment.

1.5 Outline

The paper is organized as follows. Section 2 is devoted to an informal presentation of the interactions between unemployment, public employment and labor market institutions — a simple theoretical model is presented in Appendix 1. Data and econometric evidence are presented in section 3. Section 4 provides some concluding comments.

2 The theory

2.1 The consequences of public employment on labor market performances

In theory, public jobs have an ambiguous impact on unemployment. Obviously, public jobs have a direct negative effect on unemployment U , which is just the difference between labor force N private employment L_p and public employment L_g : $U = N - L_p - L_g$. But, public jobs also have indirect effects on unemployment through their impact on private employment and on the size of the labor force.

Public jobs crowd out private employment through different channels. First, goods produced by the public sector can be substitutable to those produced by the private sector. Second, the creation of public jobs may improve the expected gains of the unemployed workers, which increases wage pressure and decreases private employment (Holmlund and Linden, 1993, Holmlund, 1997). Third, the cost of public jobs generally implies an increase in public expenditure or a public expenditure switching. In the first case, it reduces the after tax profitability of firms. In the second case, it leads to reductions in public investment or infrastructure building. In both cases, the financing consequence can be distortionary and impact negatively on the productivity of the private sector, reducing thereby labor demand in that sector.

Public jobs also influence labor force participation. A priori, the creation of public job fosters labor participation, because it improves unemployed workers expected gains, which entails a positive effect on unemployment. But public employment can also have negative effects on participation, if it is used to produce goods that are more valuable for those who are out of the labor force. Housing subsidies and some health programs for the disadvantaged are examples of such goods.

In sum, public jobs have a negative direct effect on unemployment and indirect effects that can be either positive or negative². Accordingly, there is an effect, but its sign is ambiguous in theory. In what follows, we present a simple framework that allows us to show that the impact of public jobs on unemployment hinges on the size of the rents in the public sector and on the degree of substitutability of public and private outputs. Like every model, our framework yields a partial view on the consequence of public employment. In particular, we voluntarily neglect the distortionary impact of taxes in financing public jobs in order to focus on the role of rents and the degree of substitutability of public and private employment.

²More precisely, the effect of public employment on the unemployment rate, $u = U/N$, can be decomposed as follows from the identity $U = N - L_p - L_g$:

$$\frac{du}{dL_g} N = \frac{dN}{dL_g} (1 - u) - \frac{dL_p}{dL_g} - 1$$

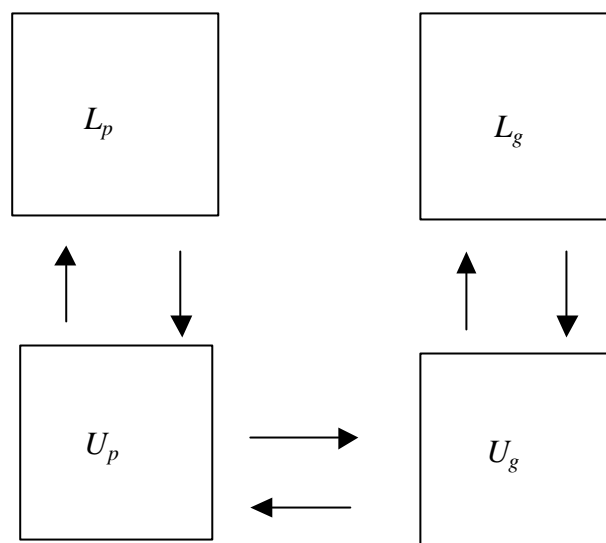


Figure 2: Labor flows in a labor market with public and private employment and unemployment. U_p , U_g , L_p and L_g stand for private unemployment, public unemployment, private employment and public employment respectively.

The size of the rents in the public sector

We consider a model — presented in Appendix 1 — with public and private jobs. The private sector is made of a representative competitive firm that produces a numeraire good thanks to a technology with decreasing returns to labor. The public sector produces a public good, consumed by all individuals. For the sake of simplicity, it is assumed that unemployed workers can look either for a public or for a private job, but not for both types of job at the same time. Indeed, in many countries, the public sector has a specific hiring process and workers need to gather some specific information to be recruited in this sector. It is assumed that unemployed workers can move across both sectors at zero cost. Accordingly, there is an arbitrage condition which implies that the expected utility of unemployed workers has to be the same in both sectors. The flows on the labor market are summarized in Figure 2.

In the private sector, wages are determined by decentralized collective bargaining. All workers who belong to the private sector are represented by a utilitarian trade-union that bargains wages with the representative firm. In this very standard framework, inspired by Layard et al. (1991), some positive level of unemployment is needed to stabilize wages. More precisely, wage bargaining implies a relationship between the wage and the unemployment rate, which is the so-called “wage curve”. In our model, this relationship is very simple: Any level of wage is stabilized by the same unemployment rate in the private sector, which means that the wage curve is vertical in the (w_p, u_p) plane, as shown by Figure 3. Concerning employment, it is assumed that firms have the right-to-manage. Thus, they stand on their labor demand and the wage is equal to the marginal productivity of labor. Accordingly, the private wage, w_p , and the unemployment rate in the private sector, u_p , are determined by the intercept of a vertical wage curve and an increasing labor demand curve in the (w_p, u_p) plane, as shown by Figure 3.

In this setting, the private unemployment rate depends on the bargaining power of workers

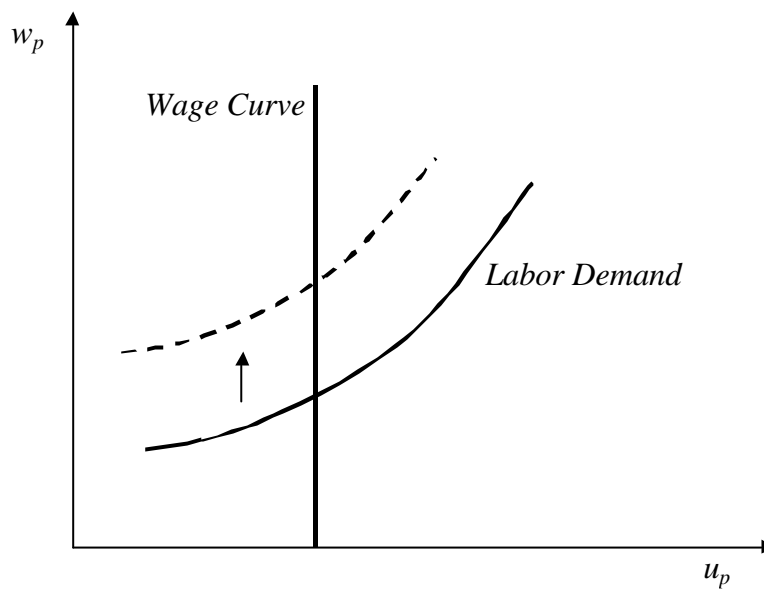


Figure 3: The consequences of a rise in public employment on the private labor market.

and on the features of the production function in the private sector. Moreover, as the (steady state) equilibrium private unemployment rate does not depend on the size of the labor force, it does not hinge on the number of workers who belong to the private sector³. Since the unemployment rate in the private sector does not depend on the number of workers who belong to the private sector, denoted by N_p , private employment, which amounts to $N_p(1 - u_p)$, is influenced by public employment through changes in the allocation of workers across sectors, i.e. changes in N_p .

Let us now focus on the public sector. It can be easily understood that the returns to unemployment in the public sector increase with the number of public jobs and with the public wage level. Therefore, the share of the labor force that belongs to the public sector (including public jobs L_g and public unemployment U_g) increases with the number of public jobs and the relative level of the public wage, w_g , with respect to the private wage, w_p . Assuming a constant ratio w_g/w_p , this implies⁴ that public jobs creation attracts workers into the public sector at the expenses of the private sector. If the participation rate is given, this will necessarily crowd out private jobs, $L_p = N_p(1 - u_p)$. Furthermore, it can be understood that the size of the crowding out effect increases with the ratio w_g/w_p , because the number of workers attracted into the public sector by the creation of one public job raises with the relative wage level of the public sector. This result is quite important from our point of view. It means, more generally, that the crowding out effect of public jobs increases with rents provided by those jobs. “Good” public jobs, providing high wages, high fringe benefits and good working conditions, relatively to what

³More precisely, this result holds either for a constant replacement ratio, such that the income of unemployed workers is proportional to the wage in the private sector, or if the income of the unemployed workers amounts to zero. Assuming that unemployed workers get an income that is not proportional to the private wage would yield more complex mechanisms than those discussed here, but with similar predictions for our purpose.

⁴Our model in Appendix 1 actually shows that collective bargaining in the public sector can give rise to a constant ratio w_g/w_p that is not influenced by L_g .

can be obtained in the private sector, crowd out more private jobs than “bad” public jobs, with low wages, low fringe benefits and bad working conditions.

It should also be noticed that public jobs raise the wage in the private sector — assuming that w_g/w_p is constant —, because the crowding out effect implies a reduction in private employment, which increases the marginal productivity of labor in the private sector. This effect is depicted on Figure 3.

The consequence of public jobs on the unemployment rate depends on the size of the crowding out effect on the private sector. Indeed, when the size of the labor force is taken as given, the creation of one public job decreases unemployment only if the crowding out effect is small enough, namely if less than one private job is destroyed. Since the crowding out effect increases with the relative level of the public wage, it can be shown that public jobs creation increases the unemployment rate if wages in the public sector are above a threshold — see equation (10). In other words, public jobs increase the unemployment rate if employees in the public sector get sufficiently high rents. It should be noticed that this result does not mean that large rents in the public sector are necessarily inefficient. Indeed, they can be a way to attract efficient workers in the public sector, and to improve overall efficiency if public and private productions are complementary.

The substitutability between public and private outputs

In our framework, the role of the substitutability between private and public productions can be illustrated by taking into account the response of participation to labor market performances. Indeed, up to now, the labor force has been assumed constant. However, it is likely that public jobs influence participation to the labor market. By raising job opportunities, public job creation is likely to increase the size of the labor force. This must soften the crowding out effect of public jobs on the private sector. However, it should be noticed that public jobs may influence participation to the labor market through other channels.

In particular, the production of the public sector can influence the private sector productivity. In order to understand such an effect, let us assume that the production function in the private sector writes as $AF(L_p)$, $F^0 > 0, F^{00} < 0$. The coefficient A satisfies $A = f(L_g)$, f being a function that can be either increasing or decreasing, depending on the type of externalities generated by the public sector. If this function is increasing, a rise in productivity due to public job creation pushes up wages in the private sector. Accordingly, the positive impact of public jobs on the participation rate is expanded. This situation can occur if public jobs produce public goods that are not substitutable to private production, and that improve productivity in the private sector. For instance, justice, police and public transportation may enter into this category. From this point of view, our model shows that the crowding out effect of public jobs is reduced if the public sector improves the productivity of private jobs. However, if public jobs produce goods that are substitutable to those produced by the private sector, the relative price of goods produced by the private sector must decrease, which can be illustrated by a decrease in A — case in which: $f^0(L_g) < 0$. In that case, public jobs contribute to reduce wages in the private sector and in the public sector — remember that the ratio w_g/w_p is constant in our framework. Accordingly, the expected income on the labor market is reduced and the participation rate decreases. Therefore, the response of labor market participation to public jobs creation expands the crowding out effect of public jobs. More generally, this line of reasoning shows that the more public and private productions are substitutable, the more private jobs are crowded out by public jobs.

2.2 Public employment setting

Public employment is influenced by many factors. Among them, the objectives of governments and the features of private and public labor markets play a key role.

The objectives of the public sector

It is worth noticing that the objectives of public and private employment are very different. Whereas private employment is aimed to maximize firms' profit, two objectives of public employment are usually distinguished (Gregory and Borland, 1999): Maximization of social welfare and maximization of personal objectives of politicians or bureaucrats.

Within this context, public employment can be used for:

- The provision of some goods, like collective goods (foreign policy, justice, army, police) or goods that cannot be produced in satisfactory conditions by the private sector (unemployment benefits, health care, prison, education... on this issue see: Tirole, 1994 and Hart et al., 1997).
- Redistribution in contexts where politicians have to circumvent opposition to explicit tax-transfer system (Coate and Morris, 1995, Alesina et al., 1998). Although there are many distortive ways of using subsidies and taxes for redistribution, it has been argued that public employment can actually be an important redistribution tool. For instance, Alesina et al. (2000) argue that about one half of the public wage bill in the South of Italy can be identified as a subsidy. They stress that both the size of public employment and the level of wages are used as redistributive device.

These remarks suggest that public employment interacts with a large range of elements, and among them, labor market institutions and performances. Our model allows us to shed some light on this issue.

Public and private employment interactions

The interactions of public and private employment can be represented in a simple framework in which it is assumed that a benevolent government sets public employment and negotiates the wage in the public sector with a utilitarian trade-union that represents the workers who belong to the public sector (see Appendix 1). In this context, one can explain both the public wage and the public employment level. In equilibrium, the public-private wage ratio depends on the bargaining power of trade unions in both sectors, and on the elasticities of private and public labor demands.

Public employment is determined by the equalization of its marginal returns to the public wage. As the public wage is influenced by the private wage, public employment hinges not only on the features of the public labor market, but also on those of the private labor market that influence the wage in the private sector. Accordingly, our model shows that the equilibrium size of the public sector depends on the valuation of the public good by individuals and on the institutional features that influence the private and the public wages. The same type of result would obviously obtain if the public labor demand were deduced from the behavior of a politician or a bureaucrat maximizing an ad hoc objective function implying a trade-off between public and private employment, or between public employment and taxes.

Eventually, our model allows us to describe the determinants of public employment and private employment by a simple set of two relations. The first relation (obtained by combining

equations (9) and (11) in Appendix 1) defines private employment (or similarly the unemployment rate) as a function of productivity in the private sector, labor market institutions and public employment. The second relation (equation (15) in Appendix 1) determines public employment as a function of the valuation of public goods, productivity in both sectors, and labor market institutions. These two relations will turn out to be very important to cope with the endogeneity problem, because they yield a coherent system that represents the interactions between public employment, private employment and other variables.

3 The facts

In this section, it is looked at the consequences of public employment from an empirical perspective. We begin to describe the data before focusing on the impact of public employment on private employment, unemployment and participation. Eventually, according to our theoretical framework, it is shown that public employment has a more important crowding out effect on private employment in countries that display high rents in the public sector and high substitutability of public and private productions.

3.1 Data

We look at 17 OECD countries over the period 1960-2000, the sample size being dictated by the availability of data. In order to remove the effect of cyclical fluctuations, we average the time-dependent macroeconomic variables over five years periods. Thus the benchmark panel consists of 17 countries and 8 observations per country, except for two countries displaying no information on public employment for the first period. The sample size of the benchmark regression is consequently made up of 132 observations. However the size of this sample is subject to evolution through the econometric analysis depending on the availability of information on public employment instruments. All data sources are listed in Appendix 2.

3.1.1 Basic data

The data on public employment deserves special comments. They derive from the OECD database and the public employment rate is computed as the ratio of general government employment on population in working age. According to OECD definition, government employment is made up of jobs belonging to central and local administration, to non-profit organizations owned or directly financed by public administrations, to army and embassies, with the exclusion of public firms. Thus it includes general public administration and public activities such as defense, justice, health or education. But unfortunately, the OECD does not provide any information on the share of employment in each of these activities, the definition of public employment being a rather bulk one. This lack of information raises a question concerning the measure of the degree of substitutability between public and private output. This issue is addressed in the next section, devoted to the formation of country groups. The unemployment rate is the traditional OECD standardized rate while the private employment rate corresponds to the ratio of total employment in business sector on population in working

Another issue is how to account for the evolution of public employment which is theoretically jointly determined by the unemployment rate and private employment. Our theoretical framework shows that private employment (or similarly the unemployment rate) can be de-

as a function of productivity in the private sector, labor market institutions and public employment, whereas public employment depends on the valuation of public goods, productivity in both sectors, and labor market institutions. To tackle this point, we refer to three sets of variables: the valuation of public goods, labor market institutions and productivity. The first set of variables refers to general determinants of the sociological and political pattern of each country. The choice of such variables is based on public employment theory and data availability. This strategy leads us to select three indicators: the urbanization rate, the total factor productivity, the political preference, the degree of centralization of public expenditures and the degree of exposure to international trade. According to Wagner's law (see eg. Musgrave, 1985), public employment evolution is deeply dragged by the development of countries and their infrastructures. In that perspective, the urbanization rate and the global productivity of factors are traditionally considered as the main measures of such development. An orientation of political preferences towards the left should foster public job creation. A high degree of centralization of public expenditure allows governments to create more public jobs for redistributive purposes. The degree of exposure to international trade may have ambiguous effects on public employment. In line with fiscal international competitiveness theory, a higher exposure should push down the size of the public sector. But Rodrik (1997) has provided arguments reversing this relation, suggesting that the public sector plays a risk reducing role in economies exposed to a significant amount of external risk.

Concerning institutional labor market variables, they jointly determine public employment, private employment and the unemployment rate. This set of variables gathers all institutions expected to affect labor market performances in the literature in line with Nickell (1997) and Blanchard and Wolfers (2000). Thus institutional variables are the same as those used in these previous studies. The unemployment insurance system is captured by the level of the replacement rate and the number of years of eligibility (benefit). The employment protection index is ranked into 20 levels according to three criteria: working time, fixed term contracts, employment protection, minimum wages and employees' representation rights. Three measures of the wage-setting framework are also integrated, namely the degree of coordination, the union coverage and the union density. The index of coordination between unions and employer is ranked from a low level of 1 to a high level of 3. The union density reports the share of union members among wage earners. But this variable is an imperfect indicator of the union weight in each country, since collective bargaining may also determine the wage of non-union members. Thus, the union coverage index indicates the share of workers covered by collective bargaining. It ranks from 1 to 3, where 1 means less than 25% covered, 2 means from 25% to 75 %, and 3 over 75 %.

3.1.2 The definition of country groups

According to the theoretical model, public employment is expected to have the strongest effect on private employment and on unemployment in countries matching two criteria. The first one is a high degree of substitutability between public and private activities. The second one is the size of rents caught by employees in the public sector in comparison to the private one. To test for this implication, we partition countries according to different indicators expected to capture these two criteria.

The first issue is to find a good measure of the substitutability of public and private employment. As stressed previously, very few data on the share of employment across the different public activities are available for a large set of countries. By contrast, much more informations

are provided on the decomposition of public spending across these activities. Thus, the measure of substitutability will be based on public expenditure decomposition, rather than on public employment data. The availability of data leads us to distinguish two measures of substitutability. The first indicator consists of the ratio of private spending relative to public spending in the health sector. This sector can be considered as one in which private and public production are among the most substitutable. Thereby, from a theoretical point of view, the lower this ratio is, the higher is the share of public spending in substitutable activities, the larger are the crowding out effects on private employment.

Table 3 reports the classification of countries according to the median of this index. Countries displaying a ratio of private spending to public spending above the median are classified under the Low substitutability index as opposed to the High substitutability index. The ranking of countries leads to two homogeneous groups, except for few cases. The relative share of public spending is rather high in the three Scandinavian countries (Denmark, Norway and Sweden) in addition to Belgium, Germany, Spain and U.K. By contrast this share is comparably low in the Anglosaxon countries (Australia, Canada, U.S.A.), in Continental European countries (Austria, France, Italy, Netherlands) in addition to Ireland and Finland. In this group, U.S.A. appears as a striking outlier since this is the only country in which the share of private spending outsets the public share. Note that Finland is the closest country of the median and could be included in the group of High substitutability joining the Scandinavian countries. But the gap between the value of its indicator and the average one of Scandinavian countries is rather significant.

The second measure of substitutability lies in the share of public spending, in total public expenditure, devoted to production complementary to private activity. To this end, we define a core set of public goods made up of defense, justice and general administration and we compute the fraction of these activities in total government outlays. These public goods are truly complementary to the private production. The higher the fraction is, the lower is public investment in production substitutable to the private one. Note that fewer data are available for this indicator, excluding four countries from our analysis. Table 3 reports the classification of countries under High and Low Substitutability index. Similarly to the previous strategy, we split the two groups according to the median except for one main exception: Denmark. This country displays a value approximately equal to Sweden and Norway. But the lack of information on European countries such as France and Italy would lead to separate Denmark from the Scandinavian countries by using the median. By contrast, our classification leads to rather homogeneous groups. The share of public expenditure in complementary goods is rather high in the Scandinavian countries (Denmark, Norway, Sweden) and the Anglosaxon countries (Australia, Canada, U.K., U.S.A.). It is worthwhile noticing that this new measure of substitutability does not match the previous classification for the Scandinavian countries. They combine a high share of public spending in the health sector with a large investment in complementary public goods. Yet the two measures lead to convergent conclusions as regards the other countries, in particular the Anglo-saxon group. In particular, it can be noticed that the correlation coefficient between our two measures of the substitutability of private and public production amounts to .80.

The second issue hinges on the size of rents in the public sector. The larger the level of rents is, the higher the crowding out effects of the public sector on private sector's jobs. This criterion raises a difficult question about the definition of rents and which variable should be used to proxy it. A first natural proxy is the wage premium indicator in the public sector compared to the private one. To that end, we use Blanchflower's (1996) indicator stemming from wage regressions on micro data sets for each countries. However, this indicator is not

available for four countries. More importantly, wage differential does not capture the extent of public rents which may also be linked to working conditions, hierarchical relationships, the extent of control and so on. Consequently, we provide a more global measure of public rents based on the Corruption Perception Index (Lambsdorff, 2000). This indicator is based on a cross-country survey in which employees in public sector, senior business people and academic experts report, according to different criteria, the degree of transparency prevailing in public administration. All survey questions hinges on the potential misuse of public power for private benefits. This definition integrates bribing of public officials, kickbacks in public procurement, embezzlement of public funds and so on. The higher the indicator is, the less corrupted are public administrations. We interpret this indicator as an indirect measure of the degree of overall control and pressure on public sector employees. Table 4 reports the clustering of countries according to these two indicators. Generally these two measures yield close classifications. In particular the Scandinavian countries display both low wage premium and low corruption in the public sector.

In the following econometric section, we test for the robustness of our results to country groups definition and the presence of outliers such as USA for the health expenditure indicator. However this sensitive analysis leads to results very close to the initial classification. We thus only report the econometric estimations using the benchmark country groups definition.

3.2 Econometric evidence

3.2.1 Basic specification

We start by estimating the additional effect of public employment in the benchmark literature relying unemployment variation to institutional variables. In lines with the pioneering work of Nickell (1997), the literature traditionally explains unemployment dispersion across countries by the underlying heterogeneity in national labor market features. The main culprit for unemployment variations is put on institutions such as unemployment benefit, the duration of their perception, the strength of unions, the tax rate and the employment protection legislation. But as illustrated by Figure 1, the different countries also display a great deal of heterogeneity as regards their level of public employment. We test if this large cross country variance also matters in explaining unemployment evolution.

To that end, we follow a two step approach. We first run the same estimation as Nickell (1997), relying unemployment to traditional labor market institutions. These variables displaying small variation over last decades, they are traditionally considered as time invariant in this literature and capture fixed country effects. We also control for specific time-varying effects by introducing as many time dummies as periods at hands. Note that the only true departure from Nickell's work is the extension of the original period ranging from the eighties to the nineties to the whole period 1960-2000. We then add public employment to this standard regression and estimate the marginal impact of this variable on unemployment. For each unemployment specification, we provide two methods of estimation. The first one is the standard OLS method. But panel data are likely to display time correlation within countries and cross correlation between countries. This is taken care of by GLS regression providing robust variance estimation.

Through the whole empirical analysis, we take the logarithm of unemployment rate, private employment rate and public employment rate. This choice is based on econometric grounds. Taking the log rather than the level does not make great difference neither on the magnitude nor on the significance of coefficient estimate (this is rather a question of scale). However, our preference

Health expenditure		Public Goods expenditure	
$\frac{\text{Private spending}}{\text{Public spending}}\%$		$\frac{\text{Complementary activities}}{\text{Total expenditure}}\%$	
Groups	Indicator	Groups	Indicator
HIGH SUBSTITUTABILITY			
Belgium	13.37	Japan	7.74
Sweden	16.80	Austria	10.24
UK	18.45	Ireland	11.41
Denmark	19.06	Spain	11.75
Norway	20.05	Finland	12.72
Spain	27.46		
Germany	28.30		
LOW SUBSTITUTABILITY			
Finland	29.95	Denmark	13.31
Netherlands	33.25	Netherlands	13.51
France	34.42	Sweden	13.86
Ireland	35.22	Norway	14.81
Austria	35.56	Canada	17.36
Italy	36.87	Australia	18.17
Canada	38.37	UK	18.84
Australia	49.56	USA	29.96
USA	128.24		
No observation			
None		Belgium, France Germany, Italy	

Table 3: Clustering of countries according to the degree of substitutability between public and private productions.

Health expenditure: share of public spending relative to private spending in the health sector (median = 29.05).

Public goods expenditure: share of defense, general public services and public order in total government outlays (median = 13.51).

Source: Health expenditure: World Bank. Public Goods expenditure: IMF.

Corruption index		Wage premium	
Groups	Indicator	Groups	Indicator
HIGH RENTS			
Italy	4.58	Japan	.21
Spain	5.94	Spain	.13
Austria	7.24	USA	.09
Japan	7.52	Canada	.09
Belgium	7.84	Ireland	.08
France	7.93	Italy	.07
Ireland	7.98	Germany	.05
USA	8.08		
LOW RENTS			
Germany	8.13	Sweden	.04
UK	8.13	UK	.04
Australia	8.30	Netherlands	.04
Sweden	8.31	Australia	.03
Denmark	8.44	Austria	.01
Finland	8.51	Norway	-.07
Canada	8.69		
Netherlands	8.72		
Norway	8.85		
No observation			
None		Belgium, Denmark Finland, France	

Table 4: Clustering of countries according to the size of rents in the public sector.

Corruption index: increasing function of the degree of transparency in the public sector (median = 8.13).

Wage premium: public-private wage differential (median = 0.06).

Source: Corruption index: Lambsdorff (2000). Wage premium: Blanchflower (1996, Tables 18-21).

for the log specification is grounded on comparison consistency with Nickell's results since this author uses the same filter. Note that we are aware of potential spurious regressions stemming from the upward trend displayed by the series of unemployment, public employment and private employment over the period at hand. An appropriate way to tackle this issue would require using series in difference. However, in this case, we would like to see to what extent the variations of unemployment are explained by variations in institutions (and not by their level). Unfortunately, the lack of data on time-variable institutions heavily hampers such a strategy.

The results of this explorative estimation are reported in Table 5. In Nickell's specification without public employment (Column 1 and Column 3), institutions seem to do a poor job in explaining unemployment. The only institution which appears significant whatever the method of estimation is the union coordination index, which steadily decreases unemployment. By contrast the positive impacts of the replacement rate, the union coverage and the union density are significant only as long as potential correlations are not taken into account. Note that in the original Nickell's article, these variables were still statistically significant under GLS estimations. By looking at the origins of the discrepancy between our results and Nickell's ones, it turns out that the period of estimation plays the key role. Specific national institutions are likely to matter during the eighties and the nineties at a time of high cross-country variation in unemployment rates. But while institutions were approximately the same from the sixties to the nineties, the unemployment heterogeneity was much less pronounced in the sixties and the seventies. Consequently, labor market institutions lose a great power of explanation when the period of estimation is extended to the four decades taken as a whole.

By contrast, public employment appears statistically significant at the 10% level whatever the method of estimation. The estimated coefficients, which range around 0.2 - 0.4, display much higher magnitude than all others institutions. Public employment catches a high share of cross country unemployment variance. This first finding suggests that the traditional literature based on the impact of institutions on unemployment has forgotten an additional key institution so far.

In order to go further into the understanding of the channel through which public employment affect unemployment, we estimate its impact on private employment. Table 6 reports OLS and GLS regressions of private employment. No matter the estimation method, public employment is found to significantly crowd out private employment, the coefficient estimates ranging from minus .18 to minus .12. As in unemployment regressions, public employment captures the main share of private variance across countries.

The invariance of these estimated effects stresses the significant link between public employment and labor market performance. However, this first off-the-shelf estimation is likely to be fraught with endogeneity bias brought about by the joint determination of public employment, private employment and unemployment. This issue is tackled in the following section.

Estimation Specification	1 <i>u</i> OLS Institutions	2 <i>u</i> OLS Institutions + Pub. Emp.	3 <i>u</i> GLS Institutions	4 <i>u</i> GLS Institutions + Pub. Emp.
Public Employment	-	.208* (.120)	-	.374* (.200)
Replacement rate	.005** (.002)	.006** (.002)	.005 (.005)	.007 (.006)
Benefit length	.005 (.039)	.000 (.039)	.005 (.091)	-.004 (.096)
Union density	.005** (.002)	.003 (.002)	.005 (.005)	.004 (.006)
Union coverage	.173 (.139)	.183 (.139)	.167 (.322)	.002 (.006)
Coordination	-.354** (.043)	-.368** (.044)	-.356** (.10)	-.380** (.106)
Tax-rate	.009** (.004)	.006 (.005)	.009 (.010)	.003 (.011)
Employment protection	.013 (.010)	.021* (.012)	.011 (.024)	.029 (.027)
Time effects	Yes**	Yes**	Yes**	Yes**
R ²	.760	.764	.760	.762
Number of observations	132	132	132	132

Table 5: Estimations of Unemployment according to Institutions and Public employment. Period of estimation : 1960-2000.

Notes: The unemployment rate and the public employment rate are taken in log.

* significant at the 90% level, ** significant at the 95% level.

3.2.2 The endogeneity of public employment

Theory predicts that unemployment, private employment and public employment are simultaneously determined. Accordingly, a major concern of our econometric analysis is whether the previous results are not deeply altered by ignoring the endogeneity of public employment.

To address this issue, we first test for the endogeneity of current public employment in unemployment and private employment OLS regressions. Since labor market institutions are time invariant, the appropriate method of estimation is by fixed effects with country-specific intercepts as a proxy for institutions. Unobservable temporary shocks are still taken into account by introducing times dummies (one per-sub period) in lines with Nickell (1997) and Blanchard and Wolfers (2000). In order to evaluate the potential endogeneity bias, we run a standard Durbin-Wu-Hausman (DWH) test. This method tests the statistical significance of the residuals of expected endogenous variables. A small p-value indicates that the residual is statistically different from zero, implying an endogeneity bias in the regression. The standard OLS regression of unemployment and private employment on the current value of public employment and the DWH tests are reported in Table 7-columns 1 & 2. The introduction of fixed-effects in place of institutional variables do not alter the nature of public employment effect. This variable significantly increases unemployment by crowding out private employment. However the DWH test clearly accepts the hypothesis of the endogeneity of current public employment, implying

Estimation Specification	1 L_p OLS Institutions	2 L_p OLS Institutions + Pub. Emp.	3 L_p GLS Institutions	4 L_p GLS Institutions + Pub. Emp.
Public Employment	-	-.112 ^{**} (.026)	-	-.188 ^{**} (.036)
Replacement rate	-.000 (.000)	-.000 [*] (.000)	-.000 (.001)	-.001 (.001)
Benefit length	.012 (.007)	.0015 ^{**} (.007)	.013 (.018)	.017 (.018)
Union density	.000 (.000)	.001 ^{**} (.000)	.000 (.001)	.001 (.001)
Union coverage	-.084 ^{**} (.028)	-.090 ^{**} (.026)	-.086 (.063)	-.096 (.066)
Coordination	.047 ^{**} (.008)	.054 ^{**} (.008)	.047 ^{**} (.019)	.059 ^{**} (.020)
Tax-rate	-.003 ^{**} (.000)	-.001 (.000)	-.003 (.002)	-.000 (.002)
Employment protection	-.004 ^{**} (.002)	-.009 ^{**} (.002)	-.004 (.004)	-.011 ^{**} (.002)
Time effects	Yes ^{**}	Yes ^{**}	Yes ^{**}	Yes ^{**}
R ² -adjusted	0.557	.566	.557	.595
Number of observations	132	132	132	132

Table 6: Estimations of Private employment according to Institutions and Public employment.
Period of estimation : 1960-2000.

Notes: The private employment rate and the public employment rate are taken in log.

* significant at the 90% level, ** significant at the 95% level.

that OLS are not consistent.

To cope with the endogeneity bias, we first instrument current public employment by its lagged value. The lagged value is computed as the previous five years average of public employment, introducing a significant period gap with its current value. However, the Figures in Appendix 3, on public employment evolutions, suggest that the adjustment process of this variable is sluggish in some countries. Thus, we also test possible endogeneity of lagged public employment by following the same previous methodology. Table 7- columns 3 & 4- reports DWH test which rejects the endogeneity of lagged public employment in both unemployment and private employment regressions. Accordingly, this instrument turns out to be consistent.

Table 7 also reports Instrumental Variable (IV) regressions of unemployment and private employment on the lagged value of public employment as instrument for its current value (columns 3 & 4). We obtain evidence that the endogeneity of public employment does matter as regards unemployment equation, while it is of remote importance concerning private employment. A comparison of columns 1 & 3 indicates that the positive impact of public employment on unemployment nearly doubles when its endogeneity status is taken into account (increase from .45 to .83). This result is consistent with our previous theoretical investigations. Public employment reacts positively to a surge in unemployment, which leads to a ratchet effect of the former on the latter. By contrast, there is weaker evidence of such differences as regards private employment. Treating public employment as endogenous or not yields close estimates. This result provides an empirical support to the idea that the variable of interest for governments is the unemployment rate and not the private employment rate.

These first estimations are rather parsimonious. Our theoretical model suggests a richer framework for explaining public employment evolution than its lagged value. Furthermore, it provides evidence that unemployment (or private employment) and public employment are jointly determined. We then go one step further by running simultaneous equations regressions (3SLS) and explicitly estimating the determinants of public employment.

3.2.3 The joint determination of public and private employment

The theoretical model lays out the interactions between unemployment (equivalently private employment) and public employment on a set of two relations. The first relation defines the unemployment rate or private employment as a function of public employment, global factor productivity, and labor market institutions (obtained by combining equations (9) and (11) in Appendix 1). The second relation (equation (15) in Appendix 1) links public employment to global factors productivity, labor market institutions and the degree of valuation of public goods. These two relations lead us to estimate a system of simultaneous equations between unemployment (similarly private employment) and public employment. The private employment equation and the public employment equation display only two main differences. First, while public employment enters into the unemployment equation, the reverse is not true. Second, public employment is determined by additional variables specific to the valuation of public goods, which do not affect the unemployment rate.

The choice of specification and instruments directly derives from this theoretical framework. The level of productivity entering the two equations is proxied by the growth rate of global productivity factors (actually, the Solow residual in the business sector) constructed by Blanchard and Wolfers (2000). The productivity term is taken in difference rather than in level in order to match the traditional Okun's law linking the unemployment rate to changes in output growth

Estimation specification	OLS		IV	
Dependent variables	u	L_p	u	L_p
Public employment	.454* (.234)	-.224 (.041)	-	-
Public employment (-1)	-		.838** (.251)	-.303* (.056)
Fixed effects	Yes**	Yes**	Yes**	Yes**
Time effects	Yes**	Yes**	Yes**	Yes**
R ²	.823	.741	0.862	.750
Number of observations	132	132	115	115
Durban-Wu- Hausman test H ₀ : exogeneity	p-value=.029 H ₀ :Rejected	p-value=.038 H ₀ :Rejected	p-value=.227 H ₀ :Accepted	pvalue=.278 H ₀ :Accepted

Table 7: Endogeneity test of Public employment and Instrumental regressions. Period of estimation: 1965-2000.

Notes: The unemployment rate, the private employment rate and the public employment rate are taken in log.

IV regressions include 115 observations instead of the 132 OLS observations since one period is removed for the lagged value of public employment.

A p-value below 0.05 rejects the absence of endogeneity of public employment at the 95% level

* significant at the 90% level, ** significant at the 95% level.

rate. Institutional variables also jointly determine unemployment and public employment evolutions. But as already stressed in the previous section, the most appropriate estimation consists in replacing institutions by country specific effects, since institutions are time invariant. We also take into account unobservable temporal shocks in both equations by introducing time dummies.

As regards variables measuring public goods valuation, the choice are dictated by theoretical literature and data availability. As claimed in the data description section, this strategy leads us to select four instruments: the urbanization rate, the political color of governments, the degree of centralization of public spending, and the degree of economic openness.

Table 8 reports 3SLS estimated coefficients for the two simultaneous equation systems: unemployment-public employment and private employment-public employment. We first focus on the impact of public employment on private employment (column 3) and the unemployment rate (column 1), the details of public employment determination being left to the end.

Let us first turn to the impact of public employment on private employment. The latter is significantly crowded out by the former: the creation of one public job destructs on average about 1.5 private job — one has from the estimates: $\log(L_p) = -0.314 \log(L_g)$, which implies that $dL_p = -0.314 (L_p/L_g) dL_g$ with $(L_p/L_g) = 4.89$ on average. The confidence interval ranks from 0.8 to 2.3. This number is larger than the one obtained by Boeri et al. (1999), who estimate a 30% crowding out effect of public jobs on private jobs. But two points distinguish our work. First, Boeri et al. abstract from the endogeneity bias of public employment in their regression, making their coefficient hardly interpretable. Second, their estimates focus on the period 1982 - 1995, neglecting the very sharp increase in public employment during the sixties and the eighties - see the Figures in Appendix 3. It is worth noticing that our estimates imply that about 12% of the private rate employment dispersion is explained by public jobs, since the adjusted R^2 amounts to 0.791 when public employment is included in the private employment equation, while estimates, non reported here, show that the adjusted R^2 amounts to 0.674 when the private employment equation only includes fixed effects, time effects and the growth rate of productivity. As regards the impact of public employment on the unemployment rate (column 1), it is still significantly different from zero. The coefficient is very closed to the one obtained with the lagged value of public employment (.883 against .853 respectively), highlighting the robustness of this relationship. In order to clarify the interpretation, it is worthwhile to compute explicitly the impact of public employment on the number of unemployed workers U . To do so, we run regressions in which the dependent variable is the ratio of the number of unemployed workers on the population in working age instead of the unemployment rate u — remind that public employment is the ratio of the number of public jobs on the population in working age. Such regressions — non reported here for the sake of space — yield results very close to those displayed in Table 8, the coefficient of unemployment being 0.83 with a standard error of 0.42, and a 95% confidence interval lying in $[0, 1.6]$. Therefore, the creation of one public job adds about 0.3 unemployed worker — $dU = 0.83 (U/L_g) dL_g$ with $(U/L_g) = 0.37$ on average —, the 95% confidence interval of such effects lying in $[0.1, 0.6]$. The comparison of this result with those obtained on private employment suggests that public employment decreases participation to the labor market. Indeed, the creation of one public job destroys about 1.5 private job and increases the number of unemployed workers by 0.3. Thus, the creation of one public job entices about 0.2 individuals away from the labor force. However, it should be noticed that the 95% confidence interval for such an effect lies in $[-1.0, 0.3]$, which should be interpreted as a non significant impact of public employment on the participation rate.

We now turn to the determinants of public employment. The most significant coefficient is

	Unemployment	Public employment	Private employment	Public employment
Public employment	.883 ^{**} (.451)		-.314 ^{**} (.083)	
TFP gap	-.039 (.024)	-.010 (.007)	.003 (.004)	-.011 [*] (.007)
Urbanization		.030 ^{**} (.004)		.030 ^{**} (.004)
Left - Right		.009 (.019)		.015 (.019)
Centralization		-.007 (.005)		-.007 (.005)
Openness		.094 (.166)		.263 [*] (.165)
Fixed effects	Yes ^{**}	Yes ^{**}	Yes ^{**}	Yes ^{**}
Time effects	Yes ^{**}	Yes ^{**}	Yes ^{**}	Yes ^{**}
R ²	0.859	0.945	0.791	0.945
Number of observations	119	119	119	119

Table 8: 3SLS Estimations of simultaneous Public employment-Private employment and Public-employment-Unemployment equations. Period of estimation: 1960-2000.

Notes: The unemployment rate, the private employment rate and the public employment rate are taken in log.

The sample size is reduced to 119 observations, the instrument "Tfp gap" lacking of informations for the ...rst period.

* signi...cant at the 90% level, ** signi...cant at the 95% level.

the rate of urbanization, which steadily increases public employment. This result is quite consistent with the theoretical literature, which considers the path of urbanization as an important determinant of public employment evolution. As suggested by Wagner's law, public employment decreases with productivity, but this effect is signi...cant only at the 90% level. Similarly, the degree of openness drags positively public employment in lines with Rodrik's results. The remaining two variables concerning the political color and the degree of public expenditure centralization are never statistically different from zero. However the instruments as a whole capture the main part of public employment evolution, the ...t of the regression in terms of R^2 being always higher than 0.94.

3.3 In which countries does public employment destroy many jobs?

The previous section provides a suitable econometric framework for evaluating the joint determination of unemployment, private employment and public employment. However the theoretical model suggests that these interactions should differ across countries according to two main criteria: the degree of substitutability between the public production and the private one and the size of rents in the public sector. The effects of these two criteria on the crowding out effect of public employment go through the wage channel. The higher is the size of rents in the public sector, the more workers are attracted to public activities, putting upward wage pressure and

thereby reducing employment in the private sector. The role of substitutability goes the same way around. In this section we evaluate the empirical relevance of these two criteria.

3.3.1 The impact of public rents

Public employment effects on labor market performance are first decomposed according to the size of rents in the public sector. Theoretically, the larger rents are, the higher is the crowding out effect of public employment on private employment, and thereby the higher is the positive impact of public employment on the unemployment rate. We test for the implication by using two measures of rents: the wage premium and the corruption index described in the previous data section. These variables are classified so that high levels of each index correspond to large rents in the public sector.

Estimations results on country groups effects are reported in Table 9 and Table 10. The two measures of rents lead to converging conclusions, providing support to the relevance of the rent effect. Table 9 indicates that public employment has significant crowding out effects on private employment only in countries in which public rents are above the median. Furthermore, the magnitude of these effects are much larger than the one found in the whole regression mixing up all countries. The coefficient estimates under the two criteria are close to minus one (columns 1 & 3) whereas it amounts to minus .31 for the whole data set regression (Table 8, column 3). This heterogeneity has direct implication as regard the impact of public employment on the unemployment rate. As indicated by Table 10– columns 1 & 3 – public employment effect turns out to be positive and statistically different from zero only in countries displaying large rents in the public sector. But once again, this positive impact becomes more than twice as large as the one found without distinguishing countries (Table 8, column 1).

	High Wage premium	Low Wage premium	High Corruption	Low Corruption
Private employment				
Public employment	-.883** (.147)	.052 (.121)	-1.116** (.279)	-.123 (.079)
Tfp gap	.018 (.007)	.002 (.007)	.0142 (.009)	.004 (.005)
Country effects	Yes**	Yes**	Yes**	Yes**
Time effects	Yes**	Yes**	Yes**	Yes**
R ²	.780	.736	.664	.753
Public employment				
Tfp gap	.005 (.009)	-.033 (.017)	.009 (.010)	-.024* (.012)
Urbanization	.034** (.008)	.037** (.012)	.012** (.006)	.030 (.005)
Left - Right	.042** (.024)	.064* (.035)	.017 (.017)	-.006 (.027)
Centralization	-.000 (.004)	-.016 (.014)	.009** (.003)	-.008 (.006)
Openness	.301** (.147)	.322 (.385)	.529** (.129)	-.388 (.412)
Fixed effects	Yes**	Yes**	Yes**	Yes**
Time effects	Yes**	Yes**	Yes**	Yes**
R ²	0.948	0.937	0.936	0.942
Number of observations	51	42	56	63

Table 9: 3SLS Estimations of the effects of Public employment on Private employment according to the size of public rents. Period of estimation : 1960-2000.

Notes: The private employment rate and the public employment rate are taken in log.

The size of sub-samples varies according to the availability of data on each clustering criterion.

* significant at the 90% level, ** significant at the 95% level.

Sources : Wage premium: Blanchflower (1996) - Corruption index: Lambsdorff (2000).

	High Wage premium	Low Wage premium	High Corruption index	Low Corruption index
Unemployment				
Public employment	2.979** (.607)	-1.561* (.816)	3.154** (.929)	-.400 (.519)
Tfp gap	-.089** (.032)	-.039 (.048)	-.039 (.032)	-.043 (.038)
Country effects	Yes**	Yes**	Yes**	Yes**
Time effects	Yes**	Yes**	Yes**	Yes**
R ²	0.888	0.847	0.872	0.875
Public employment				
Tfp gap	.000 (.009)	-.039** (.017)	.007 (.010)	-.024* (.012)
Urbanization	.041** (.009)	.037** (.012)	.019** (.006)	.030** (.005)
Left - Right	.026 (.028)	.076** (.035)	.007 (.022)	-.005 (.027)
Centralization	-.003 (.004)	-.016 (.014)	.006* (.003)	-.007 (.006)
Openness	.008 (.173)	.760** (.387)	.391** (.154)	-.422 (.413)
Fixed effects	Yes**	Yes**	Yes**	Yes**
Time effects	Yes**	Yes**	Yes**	Yes**
R ²	0.951	0.939	0.937	0.942
Number of observations	51	42	56	63

Table 10: 3SLS Estimations of the effects of Public employment on Unemployment according to the size of public rents.

Notes: The unemployment rate and the public employment rate are taken in log.

The size of sub-samples varies according to the availability of data on each clustering criterion.

* significant at the 90% level, ** significant at the 95% level.

Sources : Wage premium indicator: Blanchflower (1996) - Corruption index: Lambsdorff (2000).

3.3.2 The impact of the substitutability of public and private jobs

We now test the second proposition: the higher the extent of substitutability between public and private production, the larger is the crowding effect of the former on the latter, inducing higher unemployment rate. Two measures of substitutability are used to check for the relevance of this theoretical link. The first one corresponds to the fraction of public spending devoted to complementary goods (defense and general public administration) in total government outlays. The second consists of the share of public spending relative to private ones in health activities. The clustering of countries according to these two substitutability measures is explained in the

Data section.

Table 11 and Table 12 report clustering countries effects of public employment on private employment and the unemployment rate respectively. Once again, the two criteria lead to very close results since they gather the same countries with very few exception (see Data section). Private employment is found to be significantly crowded out by public employment only in countries with substitutable public activities (Table 11). Consequently, the positive impact of public employment on the unemployment rate turns to be statistically different from zero only in those countries as indicated by Table 12

	High public expenditure substitutable goods	Low public expenditure substitutable goods	High public expenditure in health	Low public expenditure in health
Private employment				
Public employment	-.344** (.146)	-.114 (.107)	-.302** (.056)	-.139 (.190)
Tfp gap	.006 (.007)	.012 (.007)	.006 (.004)	-.000 (.007)
Country effects	Yes**	Yes**	Yes**	Yes**
Time effects	Yes**	Yes**	Yes**	Yes**
R ²	.889	.595	.890	.692
Public employment				
Tfp gap	.001 (.017)	-.033** (.012)	-.027** (.011)	-.003 (.007)
Urbanization	.021** (.007)	.067** (.009)	.061** (.010)	.016** (.003)
Left - Right	.063 (.040)	.007 (.026)	-.001 (.034)	.007 (.017)
Centralization	.004 (.004)	-0.49** (.010)	-.001** (.034)	.008** (.004)
Openness	.448 (.291)	-.158 (.338)	1.300** (.352)	-.231** (.128)
Fixed effects	Yes**	Yes**	Yes**	Yes**
Time effects	Yes**	Yes**	Yes**	Yes**
R ²	.924	.947	.965	.946
Number of observations	35	57	54	65

Table 11: 3SLS Estimations of the effects of Public employment on Private employment according to the degree of substitutability of public production. Period of estimation : 1960-2000.

Notes: The private employment rate and the public employment rate are taken in log.

The size of the sub-samples varies according to the availability of data on each clustering criterion.

* significant at the 90% level, ** significant at the 95% level.

Sources : Fraction of public spending in complementary goods in total government outlays: IMF. Relative share of public spending in health: World Bank.

	High public expenditure substitutable goods	Low public expenditure substitutable goods	High public expenditure in health	Low public expenditure in health
Unemployment				
Public employment	1.746** (.657)	-.182 (.479)	.719** (.380)	.826 (.844)
Tfp gap	-.011 (.035)	-.098** (.045)	-.068** (.032)	-.012 (.032)
Country effects	Yes**	Yes**	Yes**	Yes**
Time effects	Yes**	Yes**	Yes**	Yes**
R ²	0.936	0.813	0.900	0.839
Public employment				
Tfp gap	-.001(.011)	-.034** (.012)	-.028** (.011)	-.003 (.007)
Urbanization	.024** (.007)	.067** (.009)	.064** (.010)	.017** (.003)
Left - Right	.021 (.045)	.008 (.026)	-.003 (.034)	.005 (.017)
Centralization	.004 (.004)	-.050** (.010)	-.030** (.008)	.007* (.004)
Openness	.308 (.276)	-.057 (.385)	1.071** (.355)	-.158 (.126)
Fixed effects	Yes**	Yes**	Yes**	Yes**
Time effects	Yes**	Yes**	Yes**	Yes**
R ²	0.923	0.947	0.966	0.946
Number of observations	35	57	54	65

Table 12: 3SLS estimations of the comparative effects of Public employment on Unemployment according to the degree of substitutability of public production. Period of estimation : 1960-2000.

Notes: The unemployment rate and the public employment rate are taken in log.

The size of the sub-samples varies according to the availability of data on each clustering criterion.

* significant at the 90% level, ** significant at the 95% level.

Sources : Fraction of public spending in complementary goods in total government outlays: IMF. Relative share of public spendings in Health: World Bank.

3.3.3 The propagation channels of public employment

The last step of our study consists in evaluating the channel through which public employment affect labor market performance. The theoretical mechanism goes from public employment to private employment through an increase in wages pressure, leading eventually to an increase in the unemployment rate. The induced upward wage pressure is expected to heavily depend on the two main criteria regarding the size of rents in the public sector and the degree of substitutability

Estimation specification	Corruption index	Wage Premium	Health public expenditure	Substitutable goods public expenditure
Public employment High indicator	.812 ** (.311)	.949 ^{***} (.295)	.366 ** (.218)	.790 ** (.207)
Public employment Low indicator	.163 (.264)	-.073 (.257)	.431 (.280)	-.299 (.243)
Inflation growth rate	-.063 (.055)	-.067 (.084)	-.049 .067	-.022 (.062)
Fixed effects	Yes **	Yes **	Yes **	Yes **
Time effects	Yes **	Yes **	Yes **	Yes **
R ²	.955	0.948	.952	.963
Number of observations	121	96	121	93

Table 13: OLS Estimations of the effects of Public employment on Wages in the Private sector. The standard errors are calculated using clustering groups. Period of estimation : 1960-2000.

Notes : The wage rate and the public employment rate are taken in log.

The sample size varies according to the availability of data on the inflation rate and on the two criteria.

* significant at the 90% level, ** significant at the 95% level.

between public output and private output. The larger these indicators are, the more workers are attracted into the public sector, putting higher pressure on private wage. We test the relevance of this channel by estimating the direct impact of public employment on the wage rate of the business sector. This variable comes from the OECD National Accounts database. To understand further the mechanisms at work, public employment effects are distinguished according to the rent and the substitutability criteria. Similarly to the previous section, we provide two different measures for each criterion. Table 13 reports the OLS estimated impact of public employment on private sector's wage. We control for specific country effects and unobservable shocks by introducing both constant and time dummies. The growth rate of inflation is also included to take account of potential Phillips mechanisms. Since countries are split in two distinct groups, the coefficient estimates standard errors are calculated by using clustering countries.

Table 13 shows that public employment increases private sector wage only in countries matching one of the two criteria, no matter the way these criteria are measured. The positive impact ranges from .366 to .943, depending on the indicator used for describing the size of rents or the degree of substitutability of production. The invariance of these estimations provides strong support to the wage mechanism underlying the theoretical model. Furthermore these results are pretty consistent with the previous estimation of the impact of public employment on private employment and the unemployment rate.

4 Conclusion

We have argued that public employment significantly influenced labor market performances in rich OECD countries over the last forty years. This issue has been surprisingly neglected and our paper hopefully sheds some light on a large obscure realm. Namely, our findings converge to two main conclusions:

- Public employment had, on average, a strong crowding out effect on private employment in rich OECD countries over the period 1960-2000.

- The impact of public employment heavily depends on the kind of public jobs created. To that extent, two characteristics of public jobs play a key role: the degree of substitutability with private production and the size of rents in the public sector.

However, our paper leaves many unanswered questions that future research will certainly address.

First, how does public employment influence private sector activities? We have stressed that public jobs crowd out private employment through different channels: Tax increases, production of goods substitutable to those of the private sector, increase in wage pressure. Our empirical results provide some hints on this issue, but much rests to be done. In particular, we did not identify the role of tax distortion.

Second, a reflection on the consequences of the size of the public sector should eventually address the issue of the optimal size of the public sector. Both data and theory are too poor to really address such an issue today.

Third, from a more methodological point of view, our focus on the endogeneity of public employment stresses the limits of the existing literature on the influence of labor market institutions on labor market performances. Our estimates suggest that the bias due to the endogeneity of public employment can be important: Neglecting its endogeneity status leads to an estimated impact of public employment on unemployment half as large as in the case in which endogeneity is taken into account. This problem certainly arises for other institutions, such as employment protection, unemployment benefits and union density, calling for future research on this key issue.

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5 Appendix 1: The theoretical model

We consider a simple model of the labor market with private and public jobs. In the private sector, a representative firm produces a numeraire output, using labor as sole input. The technology in the private sector is represented by a production function, $AF(L_p) = AL_p^\alpha/\alpha$, $\alpha \in]0, 1[$, $A > 0$, where L_p denotes private employment.

The size of the population in working age is normalized to one and N stands for the size of the labor force. There are L_g jobs in the public sector that produce L_g units of the public good, and L_p jobs in the private sector. Accordingly, the number of unemployed workers is: $U = N - L_p - L_g$. All individuals have the same preferences. The utility of an individual with an income w amounts to $w + H(L_g)$, $H' > 0$, $H'' < 0$.

We consider a framework in which unemployed workers can search either for a public job or for a private job, but not for both types of job at the same time. The motivation for this assumption is that public sector often has a specific hiring process, which requires specific knowledge and/or networks. Unemployed workers can move between sectors. They decide to search in the sector in which the return of search is the highest. In equilibrium, there is an arbitrage condition, which implies that the return of search is the same in both sectors. For the sake of simplicity, job to job mobility is not taken into account.

The allocation of workers between the private and the public sector is represented by a very simple two-stage static model: First, workers decide to locate either in the public or in the private sector. Second, wages and employment are set in both sectors. Assuming perfect foresights, this model is solved backward. Accordingly, let us first present how wages and employment are determined in each sector before analyzing the allocation of workers across sectors.

Wage and employment in the private sector

In the private sector, wages are determined by collective bargaining. There is a representative utilitarian trade-union that maximizes the sum of the utilities of the N_p workers who belong to the private sector. Let us denote by z_p the expected utility of an unemployed worker in the private sector. Assuming that unemployed workers consume the public good only, and denoting by w_p and $u_p = (N_p - L_p)/N_p$, the wage and the unemployment rate in the private sector respectively, one gets:

$$z_p = u_p H(L_g) + (1 - u_p) [w_p + H(L_g)] = H(L_g) + (1 - u_p) w_p. \quad (1)$$

The objective of the Trade-Union is:

$$V_p = L_p [w_p + H(L_g)] + \text{Max} (N_p - L_p, 0) z_p. \quad (2)$$

It is worth noticing that this representation of the trade-union preferences implies, together with the definition (1), that unemployed workers can be hired in the private sector in the 'future' with probability $(1 - u_p)$. It is well known that this type of model is a simple tool that yields similar qualitative results as those of a richer dynamic model — in a steady state — with explicit flows between employment and unemployment (see for instance, Layard et al., 1991). This approach is chosen here for the sake of simplicity.

Assuming a right-to-manage bargaining model⁵, the bargaining solution solves the standard Nash (1950) program, in which the payoffs of the trade union and the firm in case of disagreement amount to $N_p z_p$ and zero respectively:

$$\text{Max}_{w_p} L_p^\pi [w_p + H(L_g) - z_p]^\pi [F(L_p) - w_p L_p]^{1-\pi} \text{ s.t. } AF^0(L_p) = w_p \quad (3)$$

where $\pi \in [0, 1]$ denotes the relative bargaining power of workers. An interior solution, such that $L_p < N_p$, satisfies:

$$AF^0(L_p) = w_p = \mu_p [z_p + H(L_g)], \quad \mu_p = \frac{\alpha + \pi(1 - \alpha)}{\alpha} > 1 \quad (4)$$

The parameter μ_p represents the wage mark-up in the private sector. It increases with the bargaining power of workers. Substituting (4) into (1), one gets:

$$u_p = \frac{\mu_p - 1}{\mu_p} \quad (5)$$

The unemployment rate in the private sector is entirely determined by the wage mark-up⁶. It is not influenced by public employment. Nevertheless, private employment, that amounts to $N_p(1 - u_p)$, can be changed by public employment through changes in the allocation of workers across sectors, i.e. changes in N_g and N_p . Therefore, the private wage, $w_p = AF^0[N_p(1 - u_p)]$, is also influenced by the size of the public sector through changes in N_p .

The public sector

In the public sector, the probability to get a job amounts to L_g/N_g . Thus, the expected utility of a worker who looks for a job in the public sector is:

$$z_g = H(L_g) + \frac{L_g w_g}{N_g} \quad (6)$$

where w_g denotes the wage in the public sector. Henceforth, it will be assumed that the wage in the public sector is merely proportional to the private wage: $w_g = \lambda w_p$. Accordingly, the parameter $\lambda > 0$ measures the relative level of the public sector wage with respect to the private sector wage. It will be shown later that collective bargaining in the public sector can entail a public wage that takes the form $w_g = \lambda w_p$, λ being a parameter independent from the public employment level.

Labor market equilibrium

In equilibrium, the arbitrage condition implies that unemployed workers get the same expected utility in the private and the public sector:

$$z_p = z_g. \quad (7)$$

⁵ Assuming an efficient bargaining model à la MacDonald and Solow (1981) would yields the same qualitative results.

⁶ The assumption of a Cobb-Douglas technology is necessary to get this result. Assuming a non homogeneous production function would imply an unemployment rate hinging on the size of the labor force.

From (1), (5), (6) and (7), one gets a simple relation between the number of workers who decide to belong to the public sector and the number of public jobs:

$$N_g = \lambda \mu_p L_g, \text{ where } \lambda = w_g/w_p. \quad (8)$$

It can be seen that the number of workers in the public sector increases with the number of public jobs. Furthermore, the number of workers who are attracted into the public sector when public jobs are raised increases with the relative level of the public wage, measured by the parameter λ . This result is quite easy to understand: The relative returns of unemployment in the public sector increases with the relative level of the public wage.

Using (5), (9) and the identity $u_g N_g = N_g (1 - u_p)$, one gets the following relation between the unemployment rate in the private and the public sector:

$$\lambda(1 - u_g) = 1 - u_p$$

This relation shows that the unemployment rate is higher in the public sector than in the private sector if and only if wages are higher in the public sector⁷ ($\lambda > 1$). In that case, relative high wages attract more workers into wait unemployment in the public sector than in the private sector.

The equilibrium measure of private jobs, $L_p = N_p(1 - u_p)$, obtains from equations (5), (8) and the identity $N = N_p + N_g$:

$$L_p = (N/\mu_p) (1 - \lambda L_g) \quad (9)$$

This equation shows that private jobs are necessarily crowded out by public jobs. The crowding out effect increases with the ratio $w_g/w_p = \lambda$, because the attracting effect of the public sector increases with the relative level of the public wage.

Let us denote by $u = U/N$ the global unemployment rate. The identity $U + L_p + L_g = N$, together with (5) and (9) yields:

$$u = \frac{U}{N} = \frac{L_g}{N} (\lambda - 1) + \frac{\mu_p - 1}{\mu_p} \quad (10)$$

This equation shows that a public sector expansion decreases the unemployment rate if and only if $\lambda = w_g/w_p < 1$. In other words, a wage w_g in the public sector smaller than the private wage w_p entails that the unemployment rate is decreased by a rise in public employment. On the contrary, if there are high wages in the public sector, public sector booming attracts many workers into unemployment in the public sector, which contributes to increase total unemployment.

These results are obtained under the assumption that the participation rate is given. Let us now have a look at the influence of public employment when the participation rate is endogenous.

Participation rate

Let us assume that individuals can get different instantaneous indirect utility levels out of the labor market, denoted by z . The distribution of z is denoted by ϕ . Individuals decide to

⁷Holmlund (1997) gets the same result in a related but different model.

enter into the labor market, and to look for a job, only if $\frac{1}{2} + H(L_g) < z_p = z_g = z$. Therefore, the participation rate amounts to $\frac{1}{2} + H(L_g)$, where $z = H(L_g) + w_p/\mu_p$ from equations (6) and (8). As $w_p = AF'(L_p) = AF'(N/\mu_p) - \lambda L_g$, the participation rate is defined by:

$$N = \frac{1}{2} \frac{AF'(N/\mu_p) - \lambda L_g}{\mu_p} \quad (11)$$

It can easily be checked that this equation implies that the participation rate increases with public employment, because a public employment rise crowds out private jobs, increasing labor marginal productivity and wages in the private sector, which attracts workers into the labor market. As the number of private jobs amounts to $(N/\mu_p) - \lambda L_g$ (from equation (9)) any increase in participation raises private employment, and then reduces the crowding out effect of public jobs on the private sector. Accordingly, our basic model suggests that the response of participation to public employment tends to soften the crowding out effect of the public sector.

However, it should be noticed that public jobs may influence participation to the labor market through several other channels.

First, it can be the case that the public good has a different value for those who participate and who do not participate to the labor market. For instance, the production of the public sector can be more valuable for individuals who participate to the labor market. Public transportation in big cities is an obvious example. In that case, the increase in public sector fosters labor participation and the crowding out effect of public employment on the private sector is reduced by the different valuations of the public good. Several different examples may yield opposite results.

Second, the public good can influence productivity in the private sector. In order to illustrate such an effect, let us assume that the productivity parameter A of the production function, AL^α/α , satisfies $A = f(L_g)$, f being a function that can be either increasing or decreasing, depending on the type of externalities generated by the public sector on the private sector. If this function is increasing, the increase in productivity due to public job creation raises wages in the private sector. Accordingly, the positive impact of public jobs on the participation rate is expanded. This situation can occur if public jobs produce public goods that are not substitutable to private production, and that improve productivity in the private sector. For instance, justice, police and public transportation enter into this category. From this point of view, our model shows that the crowding out effect of public jobs is reduced if the public sector improves the productivity of private jobs. However, if public jobs produce goods that are substitutable to those produced by the private sector, the relative price of goods produced by the private sector must decrease, which can be illustrated by a decrease in A — $f'(L_g) < 0$. In that case, public jobs contribute to reduce wages in the private sector and to decrease the participation rate. Therefore, the response of labor market participation to public job creation expands the crowding out effect of public jobs on the private sector.

In sum, it appears that public jobs can influence the size of the labor force through different channels, and that the total effect of public employment on participation is ambiguous in theory.

Wage and employment in the public sector

Two objectives of public employment are usually considered: Maximization of social welfare and maximization of personal objectives of politicians or bureaucrats. Let us first suppose that public employment is determined by a benevolent government that maximizes the difference between the returns of the public good, $H(L_g)$ and its costs $w_g L_g$. Moreover, it is assumed that

wages are bargained between a representative trade-union and the government⁸. For the sake of simplicity, the analysis is limited to the case in which participation is exogenous (with $N = 1$) and it is assumed that public employment is financed through lump-sum transfers. In such a situation, public labor demand is given by the condition $H^0(L_g) = w_g$. Defining the objective function, V_g , of the trade-union in the public sector in the same way as in the private sector, one can write:

$$V_g = L_g [w_g + H(L_g)] + \text{Max} (N_g - L_g, 0) z_g. \quad (12)$$

The solution to the wage bargaining solves the following Nash program:

$$\text{Max}_{w_g} L_g^\gamma [w_g + H(L_g)]^{1-\gamma} [H(L_g) - w_g L_g]^\gamma \text{ s.t. } H^0(L_g) = w_g$$

where $\gamma \in [0, 1]$ denotes the relative bargaining power of the Trade-Union in the public sector. An interior solution, such that $L_g < N_g$, satisfies:

$$H^0(L_g) = w_g = \mu_g [z_g - H(L_g)], \quad \mu_g = \frac{\beta + \gamma(1 - \beta)}{\beta} > 1 \quad (13)$$

where $\beta = L_g H^0(L_g) / H(L_g)$. Equation (13), together with equation (4) and the arbitrage condition (7) implies:

$$w_g = \lambda w_p, \quad \text{with} \quad \lambda = \mu_g / \mu_p. \quad (14)$$

It can be seen that the relative value of the public wage depends on the relative values of the wage mark-up in both sectors. These mark-ups hinge on the elasticity of the labor demand and on the bargaining power of workers. According to Erhenberg and Schwarz (1986), estimated labor demand elasticity in the public sector does not appear to be substantially different than the private sector elasticity. However, trade union density is usually higher in the public sector. Such elements induce many economists to think that employees get higher rents in the public than in the private sector.

Since the public wage is equal to the marginal productivity in the private sector, (9), (13) and (14) yield:

$$H^0(L_g) = \lambda A F^0 \left(\frac{1}{\mu_p} \right) - \lambda L_g^\alpha \quad (15)$$

This equation shows that the government creates public jobs up to the point where the marginal utility of the public good $H^0(L_g)$ is equal to its marginal social cost, $\lambda A F^0(L_p)$. As the marginal cost of the public good increases with the ratio $\lambda = w_g / w_p$, a high wage in the public sector induces the government to create less public jobs.

In sum, this model allows us to illustrate the consequences of an increase in public employment due, for instance, to a more important concern for the public good. More precisely, let us assume that $H(L_g) = B L_g^\beta$, $\beta \in [0, 1]$, $B > 0$. A rise in B , which corresponds to an increase in the relative valuation of the public good, entails more public employment, according to equation (15), without any change in the wage differential between the public and the private sector, as

⁸Holmlund (1993) provided a model of union wage setting in an economy with a private and a public sector. Our model is different because Holmlund focused on the consequences of distortionary taxation that is absent from our model.

shown by equation (14). Accordingly, the mechanisms described in the main text can be interpreted as the consequences of an increase in public employment due to a rise in the valuation of the public good.

It is worth noticing that the same type of result obtains if a social planner maximizes social welfare for a given value of the public private wage ratio represented by parameter λ . In our simple framework, social welfare merely amounts to the production of the private sector, plus the utility derived from the public good. Accordingly, the program of the social planner can be written as follows:

$$\max_{L_g} - = AF(L_p) + H(L_g) \quad \text{s.t.} \quad L_p = (1/\mu_p) - \lambda L_g \quad (16)$$

It can be immediately checked that the first order condition of this program yields (15).

Assuming that public employment is determined by the maximization of personal objectives of politicians or bureaucrats would produce a similar outcome. For instance, it can be assumed that politicians face a trade-off between public and private employment. In that case, their objective can be represented by the minimization of a loss function with the following form:

$$W(L_g, L_p) = \frac{1}{2} (L_g - \hat{L}_g)^2 + \frac{1}{2} (L_p - \hat{L}_p)^2,$$

where \hat{L}_g and \hat{L}_p are two exogenous parameters. The minimization of W with respect to L_g , subject to equation (9) yields the same qualitative results as those obtained in (15).

6 Appendix 2: List of variables: Symbols, Definitions and Sources

u = Global unemployment rate as the ratio of the number of unemployed workers U on the size of the labor force N . Source: OECD National Accounts.

L_p = Private employment rate. L_p is computed as the ratio of total employees in the business sector on population in working age. Source: OECD National Accounts.

L_g = Public employment rate. L_g is computed as the ratio of total employees in the public sector on population in working age. The public sector consists of all government activities excluding public firms ownership. Source: OECD National Accounts.

w_p = wage rate in the business sector. Source: OECD National Accounts.

$Tfpgap$ = growth of total factor productivity in the private sector. Source: Blanchard and Wolfers (2000).

Employment protection = Index ranked into 20 levels according to five criteria: working time, fixed term contract, firing costs, minimum wages and employee's representation right. Source: Blanchard and Wolfers (2000).

Replacement rate = Level of the replacement rate of unemployment benefits. Time-invariant variable. Source: Blanchard and Wolfers (2000).

Benefit = duration of the unemployment benefits in number of years. The variable ranges from 0 to 4. Time-invariant variable. Source: Blanchard and Wolfers (2000).

Union density = share in percentage of union members among wage earners. Time invariant variable. Time invariant variable. Source: Blanchard and Wolfers (2000).

Union coverage = share of workers covered by collective bargaining. The variable ranges from a low value 1 to a high value 3. Time invariant variable. Source: Blanchard and Wolfers (2000).

Union coordination = extent of coordination among employees and entrepreneurs. The variable ranges from a low value 1 to a high value 3. Time invariant variable. Source: Blanchard and Wolfers (2000).

RG = Political color of governments divided into left wing and right wings. Source: Alesina et al (1997).

Centralization = degree of centralization of government expenditure. Source: Persson (2000).

Openness = degree of external exposure computed as the total share of international trade (exports plus imports) in output. Source: Penn World Table data set.

Urbanization = percentage of population living in urbanized areas. Source: World Bank Table.

Corruption Perception Index = Degree of misuse of public power for private benefits. Range between 0 (highest corruption) and 10 (lowest corruption). Source: Lambsdorff (2000).

Wage premium = percentage gap between public wages and private ones. Source: Blanchflower (1996).

Health = share of public expenditure in total health expenditure. Source: World Bank Table.

Complementary Public goods = share of public spending in defense, general public services and public order in total government outlays. Source: IMF.

7 Appendix 3: Unemployment (left scale) and public employment (right scale) rates in 17 OECD countries over the period 1960-2000.

